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Composition for depositing electroless plating catalyst on semiconductor wafers comprises metal salts, copper complexing agents, organic binders, reducing agents and base (Eng)

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NOVELTY

A composition for depositing an electroless plating catalyst on a substrate having ≤ 1, preferably 0.5 μm, apertures, comprises metal salt(s), copper complexing agent(s), organic binder(s), reducing agent(s) and base.

DETAILED DESCRIPTION

INDEPENDENT CLAIMS are also included for the following:

(a) a method for depositing an electroless plating catalyst on a substrate by contacting the substrate with a composition;and

(b) a method for manufacturing an integrated circuit by contacting a substrate with a composition, activating the catalyst and contacting the catalyst with an electroless plating solution;

(c) a method for depositing a metal seed layer on a substrate or for enhancing a discontinuous metal seed layer that has previously been deposited on a substrate comprising contacting the substrate or the substrate comprising a discontinuous metal seed layer with a composition, activating the catalyst, and contacting the catalyst with an electroless plating solution;and

(d) an electronic device comprising an electroless plating catalyst deposited from the inventive composition.

USE

For depositing electroless plating catalysts on substrates, e.g., semiconductor wafers having small geometries.

ADVANTAGE

The invention enhances or repairs discontinuities in a seed layer, particularly a copper seed layer. It allows deposition of thin copper seed layers without the use of tin. The electroless plating catalysts are neutral to alkaline and thus are less harmful to thin copper seed layers

than conventional acidic electroless catalysts.

SPECIFIC MATERIALS

The base is lithium hydroxide, sodium hydroxide, potassium hydroxide, or ammonium hydroxide.

EXAMPLE

A catalyst composition comprising 3 g/l copper chloride (metal salt), 2 g/l tartaric acid (organic acid), 11 g/l hydropropylcellulose (organic binder), 4 g/l 13 M potassium hydroxide (base), and 25 g/l hydrophosphorus acid (reducing agent), was applied on a barrier layer-coated wafer having <0.5 μm apertures. The wafer was applied with a discontinuous copper seed layer via plasma vapor deposition. The catalyst was activated by placing the wafer in an oven at 140 °C for 15 minutes. The wafer was then contacted with an electroless copper bath to provide a continuous copper seed layer. The wafer was then electroplated with an acid copper bath to provide apertures filled with copper.

TECHNOLOGY FOCUS

Inorganic Chemistry - Preferred Materials: The metal salts can be copper or palladium salts.

Organic Chemistry - Preferred Components: The complexing agents can be organic acids, preferably 1-12C alkylcarboxylic acids, 2-12C alkyldicarboxylic acids, 1-12C alkyltricarboxylic acids, substituted 1-12C alkylcarboxylic acids, substituted 2-12C alkyldicarboxylic acids, substituted 1-12C alkyltricarboxylic acids, 2-12C alkenylcarboxylic acids, 2-12C alkenyldicarboxylic acids, 2-12C alkenyltricarboxylic acids, substituted 2-12C alkenylcarboxylic acids, substituted 2-12C alkenyldicarboxylic acids, substituted 2-12C alkenyltricarboxylic acids, amine carboxylic acids, arylcarboxylic acids or substituted arylcarboxylic acids. The agents can also be organic acids, such as, formic acid, acetic acid, propionic acid, oxalic acid, malonic acid, succinic acid, glutaric acid, adipic acid, glucolic acid, lactic acid, tartaric acid, citric acid or malic acid, ethylenediaminetetraacetic acid (EDTA), phthalic acid, benzene tricarboxylic acid or salicylic acid. The base can also be tetra(1-4)alkylammonium hydroxide.
Polymers - Preferred Materials: The organic binders can be cellulose, hydroxycellulose, hydroxyalkylcellulose such as hydroxymethylcellulose, hydroxymethylcellulose and hydroxypropylcellulose, polysaccharide polymers, cellulose polymers, derivatized cellulose polymers, polymers and copolymers of ethylene oxide and propylene oxide, polyurethane polymers having alternating

hydrophobic and hydrophilic moieties, poly(maleic anhydride/methyl vinyl ether), polymethacrylic acid, poly(vinyl alcohol), or naphthalene formaldehyde condensates.
Chemical Engineering - Preferred Method: The activating step comprises heating, exposure to carbon dioxide or excimer lasers or exposure to ultraviolet radiation.
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